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OU 7-13/14 In Situ Grouting Project Support Systems

Idaho National Engineering
and Environmental Laboratory

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This engineering design file summarizes information regarding the In Situ Grouting Project in areas of fuel supply systems, tanks and vessels, and mechanical utilities.

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(See instructions for definitions of terms and significance of signatures.)

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ACRONYMS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
EDF	engineering design file
INEEL	Idaho National Engineering and Environmental Laboratory
ISG	in situ grouting
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
TFR	technical and functional requirement

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OU 7-13/14 In Situ Grouting Project Support Systems

1. PURPOSE

The purpose of this engineering design file (EDF) is to summarize information regarding the fuel supply systems for engine-driven equipment, mechanical utilities, and tank and vessel design for the In Situ Grouting (ISG) Project.

2. BACKGROUND

The ISG will be performed at the Radioactive Waste Management Complex (RWMC), located at the Idaho National Engineering and Environmental Laboratory (INEEL). The Subsurface Disposal Area (SDA) is an area of approximately 39 ha (approximately 97 acres) located within RWMC. In situ grouting is a method of injecting grout into the soil for contaminant grouting, which stabilizes the waste in the pits and trenches located in the SDA, or foundation grouting, which is used for structural foundation enhancement needed for cap installation.

Grouting in the SDA will be conducted with one or more large hydraulic excavators (i.e., trackhoe) that deploy a roto-percussion drill to inject grout into the waste under high pressure. A high-pressure grout pumping system will be integrated with the trackhoe drill. Operations, maintenance, monitoring, and radiation control systems will be deployed to support field operations. The ISG work will be subcontracted to provide and place grout to the project's specifications.

To minimize the risk of mobilizing contaminants within the waste zone, the company has chosen a single-phase, nondisplacement, jet grouting approach, which does not require injection of high-pressure air or free water. Grouting will be accomplished by driving a drill through the overburden into the waste zone. Then grout will be injected at a pressure up to 8,200 lb per square inch through nozzles in the drill stem as it is withdrawn. The injected grout will create a series of interconnected columns that form a solid monolith of soil, waste, and grout. During this process, excess grout is returned to the surface along the outside of the drill stem.

This project is anticipated to be accomplished in seven years; the first year, one drill rig will be used, and the second through seventh years, three drill rigs are anticipated to be used. The design is based on the required jet-grouting capacity of three drill rigs operating simultaneously.

3. SCOPE

This EDF covers the fuel systems, mechanical utilities, and general design information for tanks and vessels for the ISG Project as described above.

4. REQUIREMENTS

Technical and Functional Requirements (TFR)-267, "Requirements for the OU 7-13/14 In Situ Grouting Project (Customer, Project, and System)," was reviewed to extract requirements applicable to the above systems. The following requirements were found to be applicable:

1. Fuel, water, and tank systems and equipment shall be consumer grade.

2. All components shall be maintained in a stable and known condition from the annual lay-up period until the next year startup.

5. SYSTEM CLASSIFICATIONS, CATEGORIZATIONS, AND DETERMINATIONS

5.1 Safety classification

An ISG safety authorization basis document is being written to address the issue of system safety classification; however, the following determination will be assumed until the document is issued:

All equipment, with exception of the high-pressure retaining components, is classified as consumer grade.

The high-pressure pump, downstream piping, and pressure retaining drill string components are assumed to have a safety classification of safety significant because of the 10,000-psi maximum rated working pressure (INEEL/EXT-03-00316, *Feasibility Study Preliminary Documented Safety Analysis for In Situ Grouting in the Subsurface Disposal Area*).

5.2 Fuel Supply Systems

Fuel supply systems apply to equipment that must be refueled in the field. For this project, this would apply mainly to the trackhoe drilling/grouting unit, grout transport trucks, and the triplex pump diesel engines. The trackhoe and trucks would require diesel fuel. Other engine-driven equipment that might need refueling in the field would be engine-driven air compressors and electrical generators, if installed. It is most likely that this equipment will require refueling on at least a daily basis. Currently at RWMC, equipment that requires diesel is refueled using a tanker truck from the Central Facilities Area. Gasoline is available at RWMC.

A typical trackhoe unit could have a 150- to 200-gal diesel fuel tank and consume fuel at 6 to 10 gal per hour (see John Deere Model 370 Excavator specifications). Assuming a 10-gph fuel consumption rate using 120 gal of the tank capacity (to be conservative), the fuel would last approximately 12 hours of running time. From this information, it is assumed that each trackhoe would require refueling twice per day, using approximately 240 gal maximum per day. It is assumed that each refueling operation requires approximately 20 minutes at a fuel delivery rate of 6 gpm to transfer 120 gal of fuel. A typical grout transport truck would be a cement-mixing type truck with a diesel fuel tank capacity of 50 gal. A typical diesel engine rated at 450 hp consumes fuel at 28 to 40 gph (see Volvo Model GS 400 specifications). At the maximum fuel consumption rate, one triplex pump would use 480 gal in a 12-hour period. A 600-gal (minimum) diesel above ground portable storage tank (double contained and rated for above ground use) located in the vicinity of a pump could be used as the source of fuel. A fuel spill pad would need to be installed for refueling of the tank.

Because of the nature of the project (i.e., temporary and seasonal), fuel delivery would most easily be done using a fuel truck. A small tanker truck with a 1,500-gal capacity could easily handle the daily needs of the equipment for the project (depending on the number of trackhoe units in operation per day). A tanker truck should be provided with at least 50 to 100ft of hose to reach the equipment fuel tanks. It is assumed that small fuel delivery trucks can be used for refueling in the SDA since grout trucks can access the SDA.

Refueling of equipment should be performed when grouting operations are not occurring. This will avoid potential mishaps that might cause a shutdown of the grouting systems and necessitate grout hose and drill string cleanout. Each engine-driven unit should be provided with enough fuel capacity to operate for at least a 24-hour period.

5.3 Mechanical Utilities

Water will be needed at the grout mixing plant. Water will be used not only for the mixing process, but also the cleanup process. Aboveground temporary piping or hoses can be run from the nearest water source. If the source pressure and capacity is insufficient to dispense water to an SDA location, then a water surge tank and pump can be installed near the source to increase the water pressure and capacity. Poly tanks can be used for water storage. This arrangement would provide the greatest flexibility and would be more adaptable to changing work areas within the SDA.

Water usage has been estimated at approximately 50 gpm (see EDF-5135, "OU 7-13/14 In Situ Grouting Project Grout Storage and Mixing," for line size) during a 12-hour shift with a total required capacity of 36,000 gal/shift or gal/day. With 20,000 gal in storage capacity (i.e., four 5,000-gal polyethylene tanks), and a 25 to 30-gpm continuous makeup, this daily capacity could be obtained. The poly tanks would be installed in the grout mixing area to provide ready access to water for the daily needs. An aboveground water line would be routed from the nearest source to the storage tanks located in the grout mixing area. Aboveground routing of a water line necessarily assumes that work will be performed during a season when outdoor air temperatures are above freezing unless the piping is insulated or otherwise protected from freezing. The size of the water line should be at least 2 in. This size will allow the full 50-gpm flow if needed.

At RWMC water is pumped from a well with a 200-gpm pump into a 250,000-gal storage tank near Building 603. This tank is the reservoir for both the potable and firewater systems. To obtain water for grout mixing and other operations, a new water supply pump or pumps (50 gpm maximum) should be installed that can tap directly into the 250,000-gal storage tank, or piping not impacting the existing pumping systems. Controls may need to be installed to cut off operation of the new ISG water supply pump when the firewater pumps are in operation.

Compressed air may also be required. Air might be used for blowing out the grout lines. Portable compressed air equipment at or near the location of use can be used to supply what is required.

5.4 Tanks and Vessels

Tanks and vessels will be of various sizes and uses. Atmospheric tanks may be used for grout dry storage, grout mixing, and raw water storage. Pressurized tanks, if used, will be required to conform to national codes for pressure vessels.

Atmospheric pressure polyethylene tanks are economical for water storage and are readily available. Polyethylene tanks are also capable of being relocated as project conditions change. The poly tanks will require wind restraints attached to adequate structural elements (e.g., concrete blocks).

6. ASSUMPTIONS

The following are assumptions for support systems for the ISG Project:

1. All operations involving the use of water outdoors will be performed during periods when the outdoor air temperature is above freezing.

2. Existing refueling methods and systems will be available for continued use to the project.

3. A water source will be available at RWMC to supply water to grouting operations without trucking water from another area at the INEEL.

4. The existing water system at RWMC can support a continuous water flow of 30 gpm.

5. Grouting operations will occur only during one 12-hour shift per day.

7. DESIGN CRITERIA

Redundancy—The water supply pump shall have a backup pump to prevent unavailability of the water supply system.

7.1 Applicable Design Codes and Standards

All systems shall comply with the appropriate national consensus code, detailed as follows:

Tanks or vessels (excluding water tanks under 120-gal capacity and vessels less than 6-in. in diameter) (see American Society of Mechanical Engineers [ASME] Code, Section VIII, Division 1, Subsection U-1(c)(2)(h)) which could be pressurized to 15 psig or above shall be designed and code stamped in accordance with ASME Code, Section VIII, Division 1, "Rules for Construction of Pressure Vessels." These vessels shall be equipped with ASME-stamped safety valves. Electrical system components (such as electrical control panels, junction boxes, and switches) shall be National Electrical Manufacturers Association-rated for the environment in which they will be operating.

Fuel gas piping and systems, if used, shall comply with American National Standards Institute (ANSI) Z223.1, "National Fuel Gas Code."

Onsite diesel fuel storage tanks are not anticipated; however, if they are installed, secondary containment and inspections in accordance with INEEL standards are required.

7.2 System Design Requirements

The following are system design requirements for support systems for the ISG Project:

1. Water supply piping is sized for a maximum fluid velocity of 5 ft/sec.

2. Low-pressure water systems shall have a maximum design pressure of 150 psig.

3. A water supply source and the supply system need to be sized to deliver an approximate 50-gpm maximum during grouting operations.

8. RISKS

Risks associated with refueling equipment and systems will already be addressed by the use of existing refueling equipment and systems.

Water supply risks are associated with equipment failure. Water supply will be obtained from the existing water storage tank at RWMC. A water supply system failure could have an impact on ISG operations, depending on ISG water supply storage and redundancy in the ISG water system. The minimum amount of storage would occur near the end of a shift. For 20,000 gal of total storage, the storage capacity will vary from 20,000 gal at the beginning of a shift to 5,600 gal at the end of a shift (i.e., 20,000 gal less 14,400 net usage or 20 gpm storage loss in 12 hours). During the off hours, the storage capacity will be totally replenished at the 30-gpm rate. Another risk associated with the water supply system is the basis for the design capacity of the system. Water usage above a 50-gpm average could deplete the storage capacity before the end of a shift.

9. LOGISTICS SUPPORT

Scheduling of refueling operations will be the most difficult scheduling task. Fuel tank levels in the equipment will need to be monitored on a daily or more frequent basis to schedule fuel deliveries. Fuel usage will be dependent on the running time of the equipment.

10. RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Refueling systems and techniques are already in place and operating. Use of existing refueling equipment and systems will be the most economical to the project.

11. REFERENCES

ANSI Z223.1, National Fuel Gas Code.

ASME Code, Section VIII, Division 1, Rules for Construction of Pressure Vessels.

EDF-5135, OU 7-13/14 In Situ Grouting Project Grout Storage and Mixing.

INEEL/EXT-03-00316, Feasibility Study Preliminary Documented Safety Analysis for In Situ Grouting in the Subsurface Disposal Area.

TFR-267, Requirements for the OU 7-13/14 In Situ Grouting Project (Customer, Project, and System).